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Supplying Energy For Milk Production

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DAIRY
FEEDING
BREEDING
MANAGEMENT

Supplying Energy for Milk Production

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The first requirement for an economical dairy feeding program - under most conditions - is to provide the dairy herd all the top quality forage it will eat. However, most harvested forages in Indiana will supply enough energy for body maintenance and only about 10 to 20 pounds of milk (Table 1).

Concentrate feeding is necessary for maximum milk production. The reason is simple--most cows cannot eat enough to supply their milk production needs. As forage quality and consumption decrease, milk production decreases unless the cow receives additional concentrates to meet her nutritional needs.

How the Cow Uses her Feed

Any machine is operated most economically at or near full capacity; the same is true with the dairy cow.

When fed a full ration, a good dairy cow can use about half of her feed for milk production. When fed a three-fourth ration, she can use about one-third of her feed for producing milk, and when fed a half-ration, she needs all of her feed to maintain her body (Figure 1).

It is just as unwise to overfeed a cow when she only has the ability to produce so much milk. The extra feed will be used for body fat. This often occurs in herds where all cows are fed the same amount of feed regardless of their production. Some will lack the inherited ability to produce as much as others in the herd.

Requirements of a Dairy Ration

The dairy ration must contain a liberal supply of energy or total digestible nutrients (TDN), sufficient protein, sufficient fat and

Table 1. Effect of forage quality on forage intake and milk production

Quality	Dry matter intake per 1000 lb body weight*	Digestibility	Potential milk from forage
	pounds	percent	pounds
Top quality pasture	35	71	50+
Excellent pasture, hay or silage	30	63	34
Good pasture, hay or silage	25	60	20
Average pasture, hay or silage	20	55	10
Poor pasture, hay or silage	15	50	0

*Dry matter intake is the amount of forage consumed minus its water content.

Level of feeding	Use made of feed nutrients			
1/2 Ration	MAINTENANCE			
3/4 Ration	MAINTENANCE	MILK		
Full Ration	MAINTENANCE	MILK		
Over-Feeding	MAINTENANCE	MILK	BODY	FAT

Figure 1. How a cow uses her feed.

an adequate supply of minerals and vitamins. Water is also important. These materials must also be provided in a ration that is palatable to the cow.

The greatest needs of the dairy cow are protein and energy. Protein is important, both nutritionally and cost-wise. The amount needed in the concentrate ration will depend upon the forage being fed. (See Mimeo DH106) However, milk production requires 7 to 10 times as many nutrients from energy sources as from protein nutrients.

Net Energy?? or TDN??

Energy is the most common deficiency in dairy cows. It is often expressed as TDN or estimated net energy. Although derived differently, either of these terms may be used in determining the cow's requirements and expressing the nutritive value of feeds.

What is TDN? It is the total nutrients of a feed after subtracting the undigested portions that pass through the digestive tract. It does not include the losses in the work required for digestion, rumen gases or losses in the urine. Therefore, it represents the amount of energy remaining in the feed that is available to the animal. Not all, but a large share of this energy is available for productive purposes. It is popular because it is relatively easy to determine and is expressed in pounds or percentages. Its main fault is the over-estimation of the value of most forages.

Net energy measures the actual energy available for productive purposes. It attempts to account for all of the losses in energy (feces, urine, work of digestion and rumen gases) of a feed. It is commonly expressed in calories or therms. Its main fault is that it is difficult and expensive to determine. Therefore, most net energy values are estimated and good estimates are not available on some feeds. Where animals are being maintained outside in cold weather, net energy values should not be used to compute maintenance requirements--the work of digestion provides heat used to keep the body warm so TDN values are more appropriate.

For most practical purposes either TDN or estimated net energy may be used. While considerable variation may occur in forages, the values on concentrates and forage-concentrate mixtures are quite similar. The main precaution in the use of either is to use only one system in determining the cow's requirements and the value of feeds being fed. Under DHIA Central Processing the individual needs of the cow and nutrients provided by the various feeds are expressed as Estimated Net Energy.

Energy Needs of the Cow

The ration must supply sufficient energy for the cow's body maintenance, milk production and, at times, reproduction and growth.

Body Maintenance--The larger the cow, the greater is the need for energy for maintenance (see Table 2).

Table 2. Daily energy needs for maintenance

Body weight	Estimated net energy		TDN
pounds	therms		pounds
800	5.2		6.5
1,000	6.3		7.9
1,200	7.4	or	9.3
1,400	8.5		10.6
1,600	9.6		11.9

Table 3. Additional energy needs for growth

Additional allowances per day	Estimated net energy	TDN
First lactation	1.5	1.8
Second lactation	0.8	.9

Table 4. Reproduction (last 2-3 Months)

Additional allowances per day	Estimated net energy		TDN
	therms		pounds
1,000# cow	5.1	or	6.0

Table 5. Daily energy needs for milk production (amount needed for each 10 pounds of milk)

Butterfat	Estimated net energy		TDN
percent	therms		pounds
3.0%	2.6		2.8
3.5%	2.8		3.0
4.0%	3.0	or	3.2
4.5%	3.2		3.5
5.0%	3.5		3.7

Table 6. Energy requirements for maintenance and milk production

Item	Estimated net energy		TDN
	therms		pounds
Maintenance--			
1,200 pounds	7.4		9.3
Milk production--			
60 lb. of 3.5%	16.8	or	18.0
Total daily energy requirement	24.2		27.3

Growth--First and second lactation cows should receive additional energy to allow for an increase in body size. Table 3 indicates their needs for growth and maintenance.

Reproduction--Additional energy should be allowed during the last two to three months of pregnancy. Condition of the cow will determine if the additional allowances should be made. (See Table 4.)

Milk Production--The amount of energy needed for production depends on the amount of milk produced and its fat content (Table 5).

The total daily energy requirements can be obtained by adding the requirements together. For example, a mature 1,200 pound cow producing 60 pounds of 3.5 percent milk would require the amount of energy shown in Table 6.

How to Use Feeding Standards

Feeding standards are fairly accurate and are especially helpful in showing the deficiencies of a particular herd ration. They should be used only as guides because the needs of individual cows vary and depend upon environmental conditions, activity of the animal, individual variation in feed utilization and other factors. They provide no consideration of physiological effects of the ration or

economic aspects. They do indicate the approximate needs of the cow and act as guides for meeting her requirement through proper feeding. In this respect, they avoid wasteful over-feeding or possible low production from under-feeding.

Calculating the Energy from Forage

The contribution of forage to energy needs can be calculated by knowing its energy content and the amount consumed. Table 7 shows the estimated net energy and TDN values of various forages.

As an example, let us assume that we are feeding about 15 pounds of average alfalfa hay and 45 pounds of well-eared corn silage per cow daily. The energy from the hay and silage can be determined as follows (using TDN values in Table 8):

15 lb hay x .507 (TDN per lb.) =	7.6
45 lb silage x .198 (TDN per lb.) =	8.9
Total energy from forage	16.5

Knowing the total daily requirements and the amount of energy obtained from the forages, we can calculate the difference that must be supplied by concentrate feeding.

	TDN
Total daily energy requirement (1,200 lb cow - 60 lb of 3.5%)	27.3
Total daily energy from forage	16.5
Need in grain mixture	10.8

Energy from Grain

Most concentrate mixtures will average about 75 percent TDN per 100 pounds of mixture. (Table 8) Assuming that it contained 75 percent TDN, we would need to feed the above cow:

$$\frac{10.8}{.75} = 14.4 \text{ lb of concentrate}$$

The next step is to calculate the percent protein needed in the ration so it isn't the limiting factor for milk production (See Mimeo DH-106).

Knowing what the average cow (or several cows) is to be fed, does not tell the grain feeding rate for the individual cows in the herd.

Periodically, the dairyman should take time to study the milk records of individual cows. Feeding based on the needs of the cow during lactation aids in keeping feed costs at a minimum and results in a more profitable distribution of the grain fed.

Adquate feeding in early lactation allows cows to reach their highest milk producing potential.

Summary

1. Energy is the most common deficiency in dairy cows.

2. Forages will need supplemental concentrate feeding for high milk production.

3. The cow must meet her body maintenance requirement before feed can be converted into milk.

4. Either TDN or estimated net energy values may be used to express the energy needs of the cow and the value of feeds.

5. Energy allowances should be made for maintenance, milk production, and at times, growth and reproduction.

6. Feeding standards may be used as guides in feeding the dairy herd.

7. Calculations of the energy from forages will help show the amount of concentrate feed needed for milk production. This feed must also contain adequate amounts of protein.

Table 7. Estimated net energy values of forages

Dry Forages	Estimated net energy 100 lb	TDN
	therms	percent
Alfalfa hay, all analyses	40.6	50.7
Alfalfa hay, leafy	41.5	51.2
Alfalfa hay, stemmy	33.3	46.3
Alfalfa and grass hay	38.6	48.3
Bromegrass hay	38.0	49.3
Clover, Ladino & grass hay	45.9	57.4
Clover hay, Red, all analyses	41.4	51.8
Corn stover, (ear removed)	27.5	51.9
Lespedeza hay, annual, in bloom	36.5	49.2
Mixed hay, good, 30%+ legumes	38.6	49.5
Sudan grass hay	36.5	48.6
Silages		
Alfalfa, wilted (36% Dry Matter)	17.6	21.5
Alfalfa, not wilted (25% D.M.)	11.1	13.5
Alfalfa-grass, wilted (36% D.M.)	17.4	21.2
Corn, dent, well-eared, well-matured (28.5% D.M.)	15.2	19.8
Corn, dent, fair-eared, well-matured (26.3% D.M.)	13.8	17.2
Corn, dent, immature, before dough stage (20.3% D.M.)	11.0	12.9
Corn, stover silage, ears removed (23.7% D.M.)	9.1	14.0
Grass silage, small proportion legumes, wilted (37% D.M.)	17.9	21.1
Ladino clover and grass (30% D.M.)	18.2	21.4
Sorghum, sweet (25.4% D.M.)	12.2	15.2

Table 8. Estimated net energy and TDN values of concentrates

Concentrates	Estimated net energy 100 lb	TDN
	therms	percent
Barley, common	80.1	77.7
Barley, light weight	61.5	69.0
Beet pulp, dried	76.1	68.7
Brewers' grains, dried	66.9	67.1
Corn, dent No. 2	80.1	80.1
Corn, dent, soft or immature	58.8	60.6
Corn and cob meal	72.1	73.2
Corn gluten feed	71.1	74.1
Corn gluten meal	80.2	79.7
Cottonseed meal, 43%, solvent	69.0	65.2
Cottonseed meal, 41%, solvent	63.3	63.3
Linseed meal, all analyses	77.0	75.5
Milo, grain	77.8	79.4
Molasses, blackstrap	71.3	53.7
Oats	72.1	70.1
Oats, light weight	59.6	59.8
Soybean oil meal, solvent, 44%	79.6	78.0
Soybean oil meal, solvent, 50%	80.1	79.4
Soybean seed	87.6	87.6
Wheat, average	80.0	80.0
Wheat bran	66.9	66.9

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